Relieving Congestion Through Active Traffic Management

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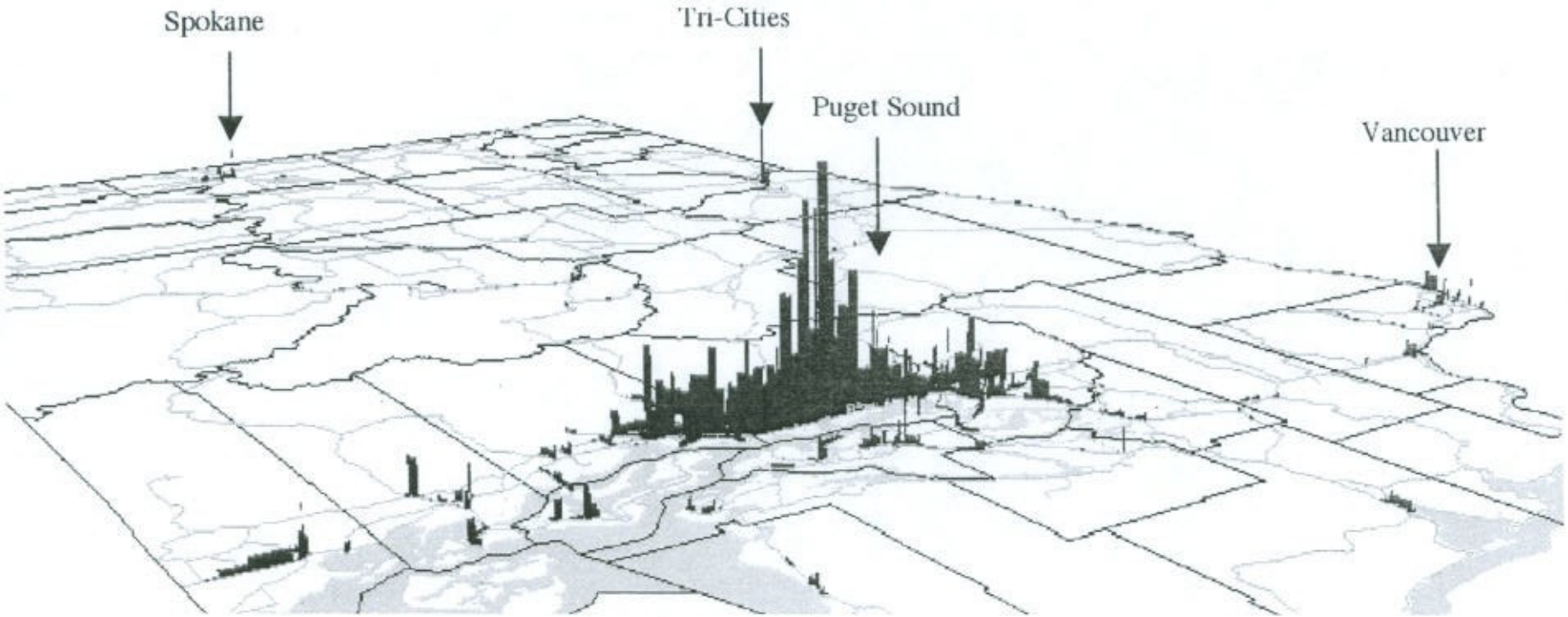
Puget Sound Regional Council

(with material shamelessly stolen from Craig Stone and Ted Trepanier at WSDOT)

Highway Congestion – Statewide Perspective

Annual hours of vehicle delay on state highway segments in urban areas

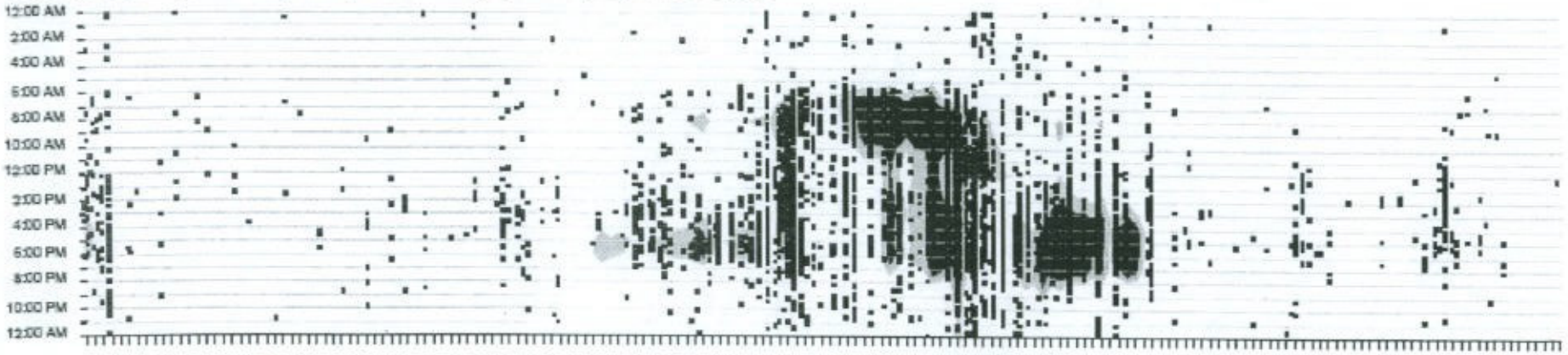


- 370,000 vehicle hours (520,000 person hours) daily delay (2004)
- Chiefly affecting urban areas and especially the Puget Sound region

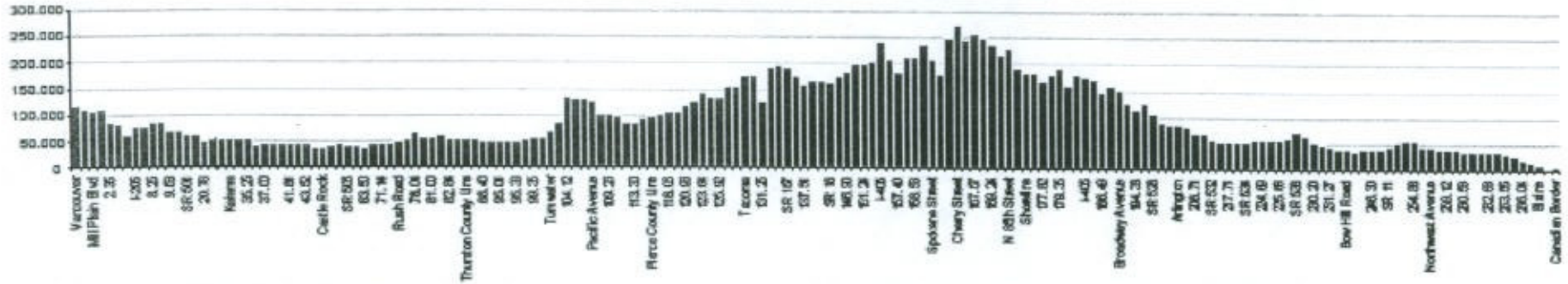
Linking Congestion and Safety

Northbound Interstate 5: 2005 Rear End Collisions and Congestion Occurances

Collisions (squares) and Congestion (shaded areas) by Time of Day and Location



2005 Annual Average Daily Traffic, Hours of Delay by Milepost (correlates with graph above)



Estimated 2005 General Purpose Lane Performance

* Federal Law Title 23 U.S. Code Section 409 prohibits the discovery or admission into evidence of this data in Federal or State Court proceedings or consideration in any action for damages.

Traffic Math 101- Exercise
Calculating Maximum Lane Capacity

Everybody is a Traffic Engineer

How is maximum lane capacity calculated?

What is the recommended separation (following distance) between vehicles?

The two-second rule or 2 seconds

How many seconds in an hour?

60 seconds times 60 minutes= 3,600 Seconds

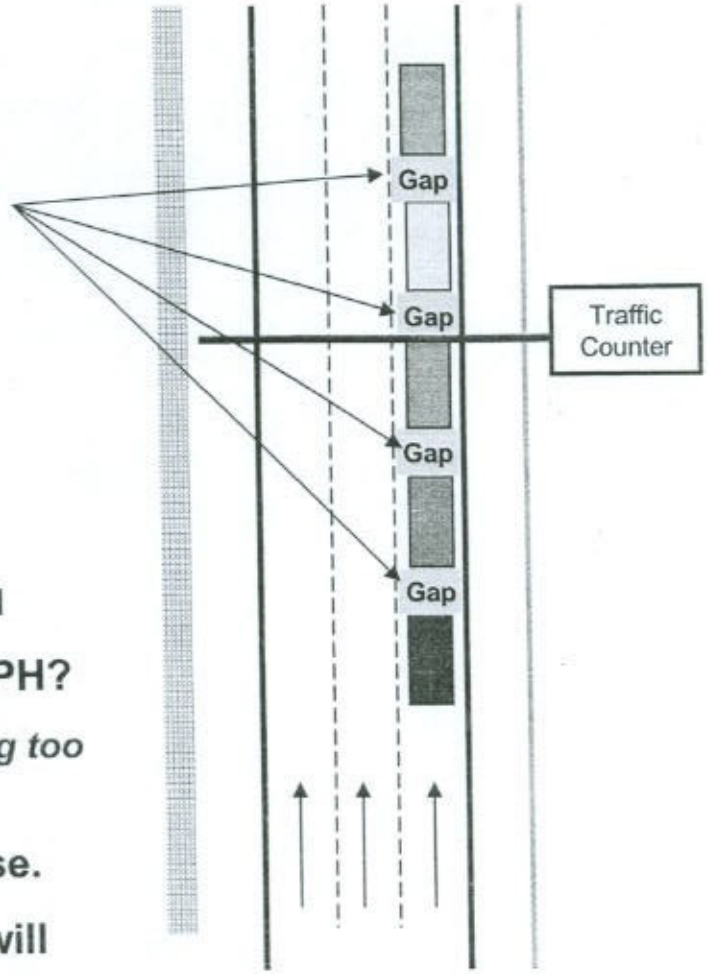
3,600 seconds divided by 2 second gap = **1,800 VPH**

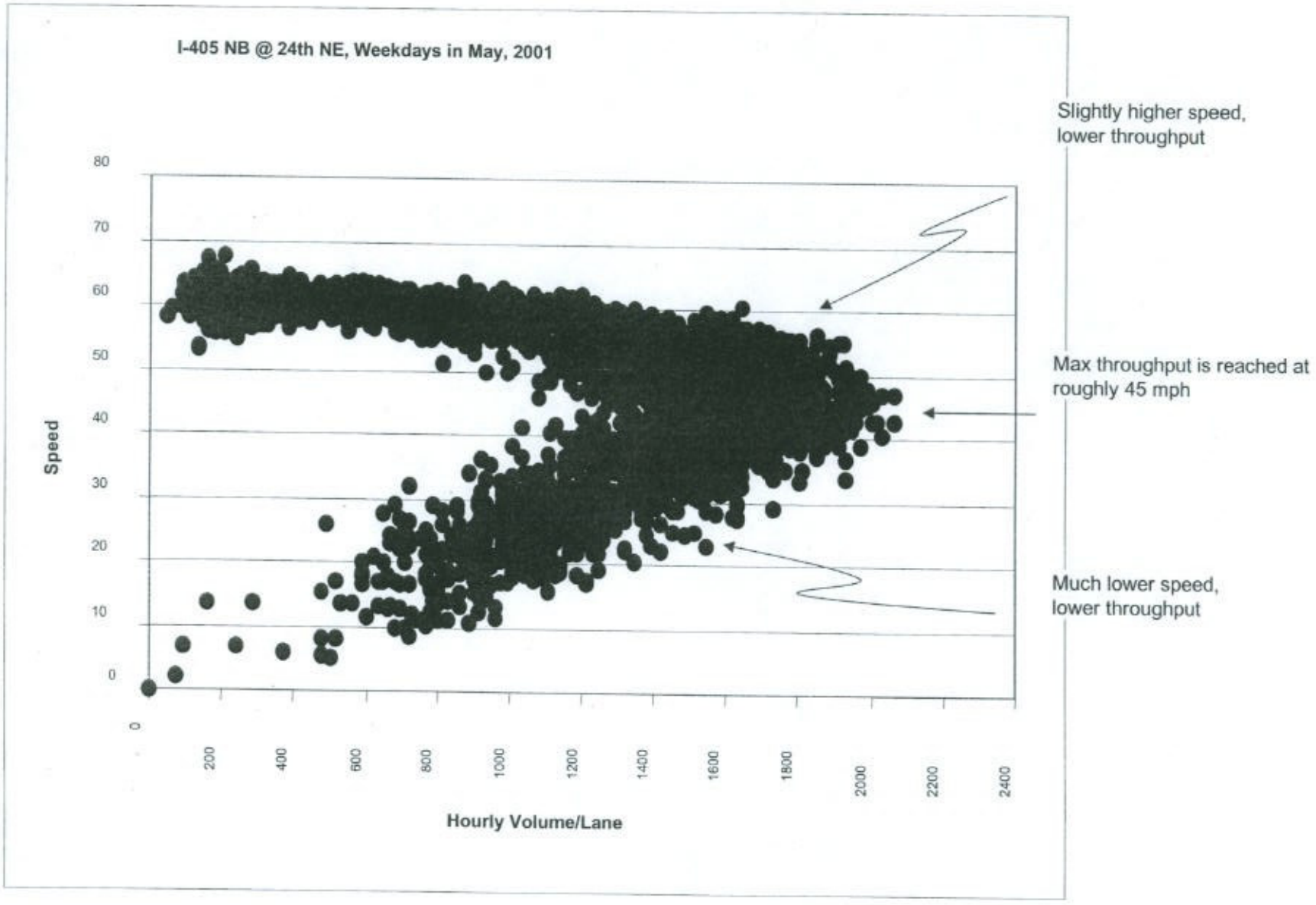
So how do we get traffic flows at 2000 or 2200 VPH?

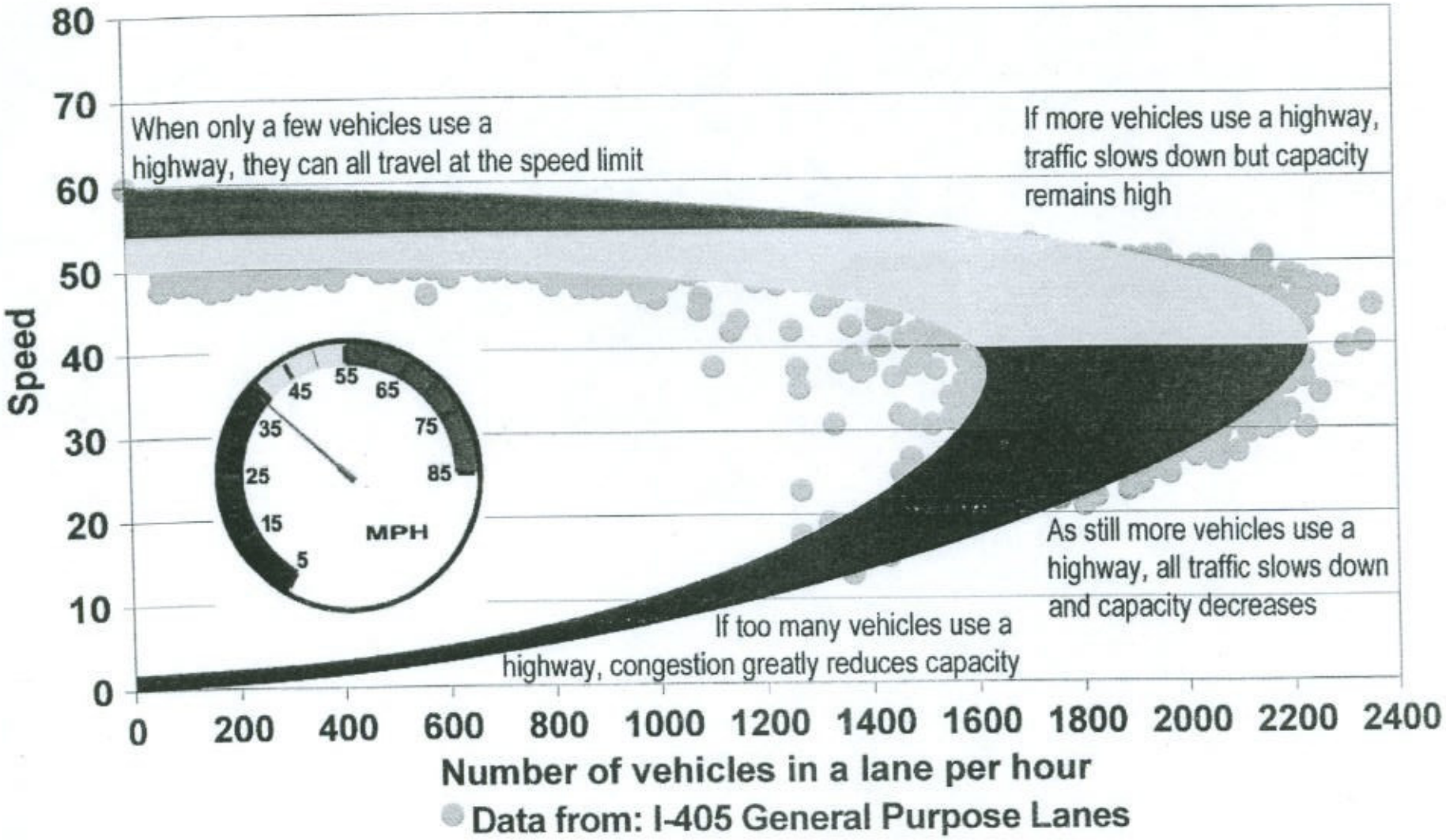
Smaller Gaps- which means that everyone is following too closely!

That is why fragility increases as speeds increase.

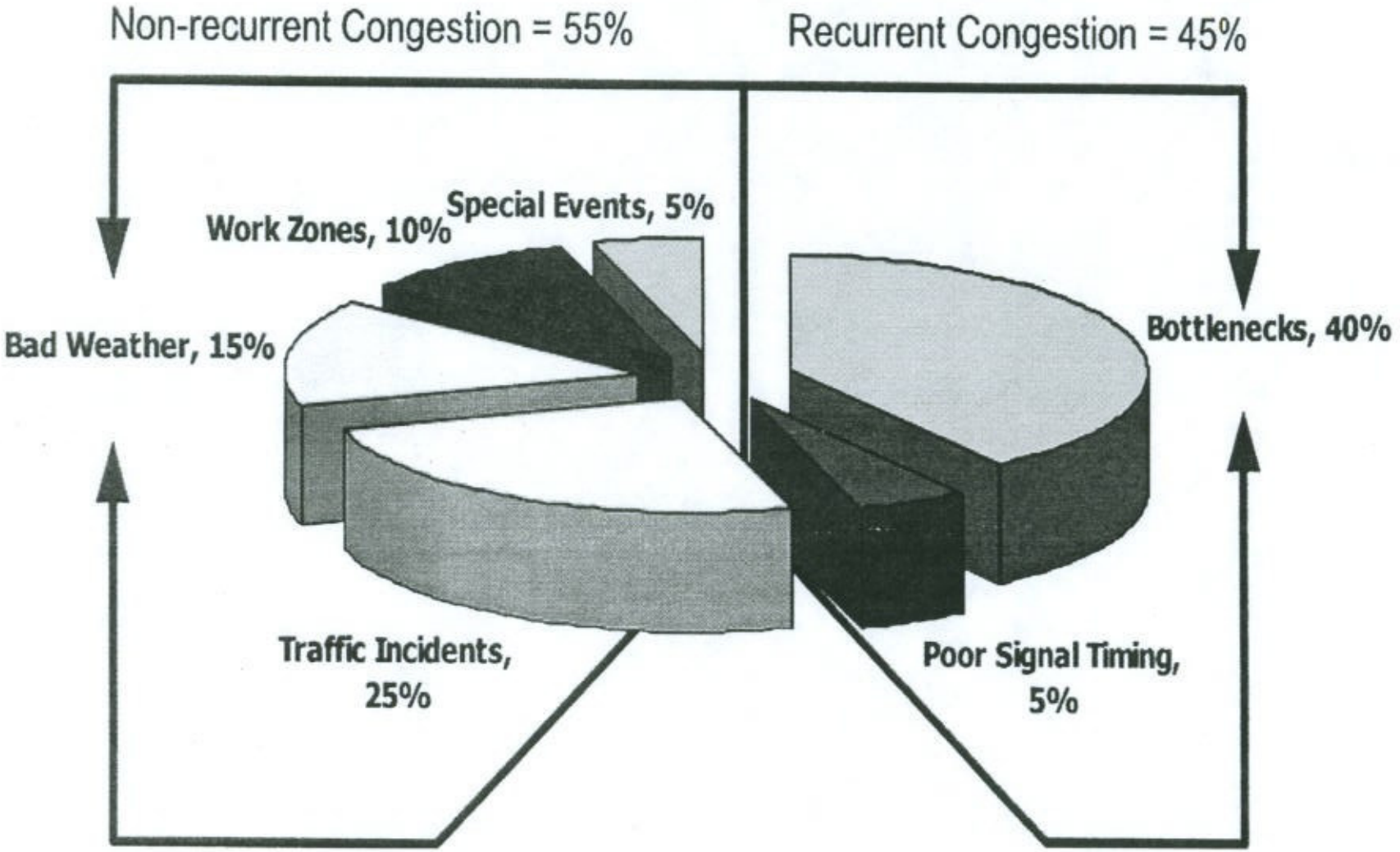
Fragility means that just about any distraction will cause a capacity reduction!

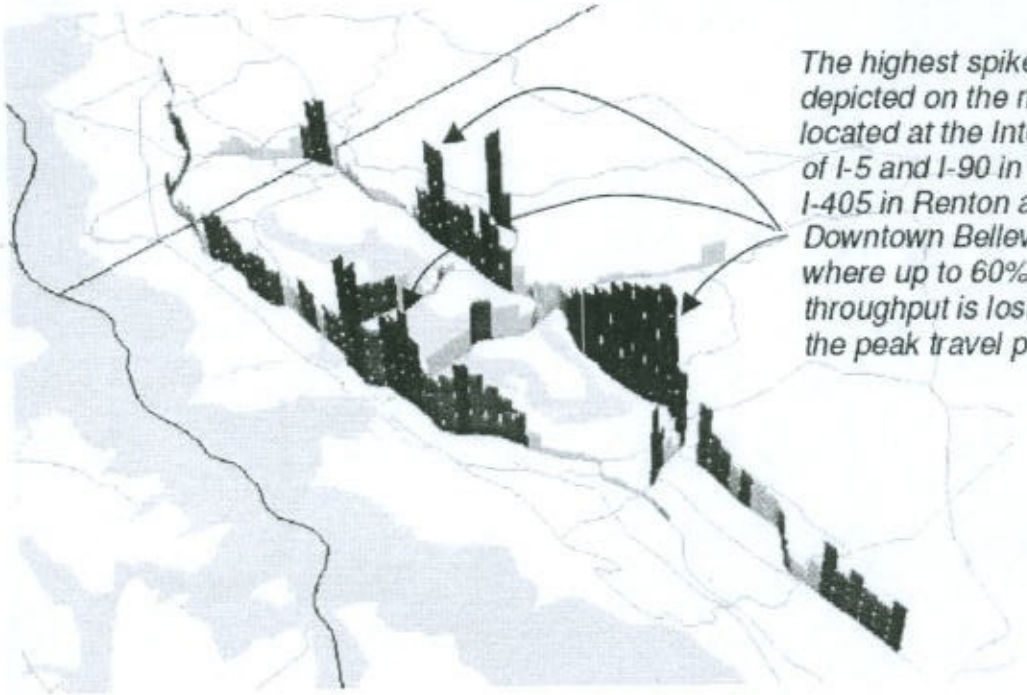



I-405 NB @ 24th NE, Weekdays in May, 2001
Speed
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
Hourly Volume/Lane
Slightly higher speed, lower throughput
Max throughput is reached at roughly 45 mph
Much lower speed, lower throughput


When only a few vehicles use a highway, they can all travel at the speed limit
If more vehicles use a highway, traffic slows down but capacity remains high
As still more vehicles use a highway, all traffic slows down and capacity decreases
If too many vehicles use a highway, congestion greatly reduces capacity
MPH
Speed
0
10
20
30
40
50
60
70
80
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
Number of vehicles in a lane per hour
Data from: I-405 General Purpose Lanes

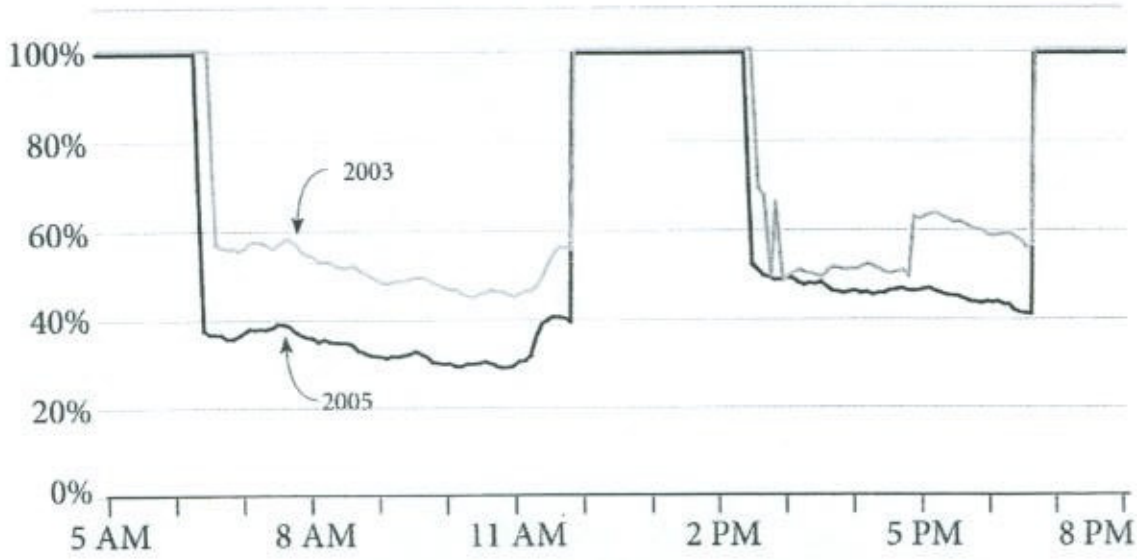
Causes of Congestion





The highest spikes depicted on the map are located at the Interchange of I-5 and I-90 in Seattle, I-405 in Renton and Downtown Bellevue where up to 60% of the throughput is lost during the peak travel period.

I-5 at I-90



Progression of Traffic Management in Washington State…

- I-5 Express lanes in Seattle
- Variable message signs
- Highway Advisory Radio
- Ramp meters
- High occupancy vehicle lanes
- Incident response program
- Traveler information
- Signal system management
- Managed lanes
- Vehicle-infrastructure integration approaches

1970

|

1980

|

1990

|

2000 +

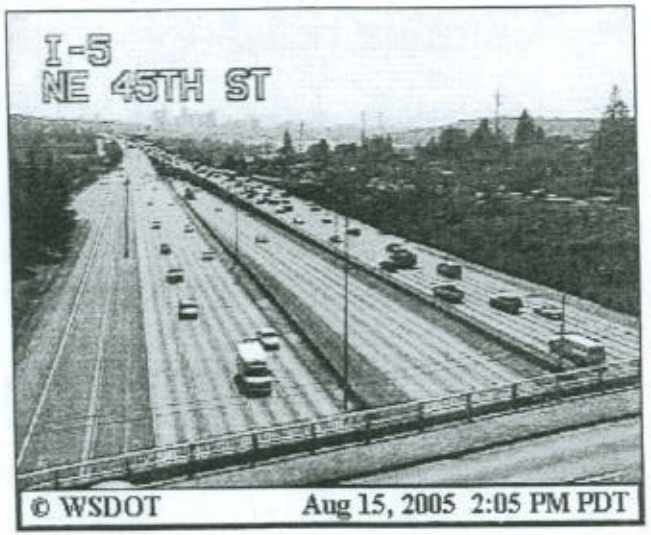
Early Traffic Management - 1967

I-5 Express Lanes

In 1967, WSDOT opened express lanes in Seattle

This led to:

- The first traffic management center in Seattle
- Freeway cameras



Signs and Radios

Variable Message Signs (VMS): The WSDOT VMSs are capable of displaying messages remotely from the TMC or locally.

Highway Advisory Radio (HAR): HAR is used as a driver information tool to warn motorist via their car radio of:

- Roadway closures
- Road restrictions
- Weather conditions
- Major traffic incidents

Technology and Congestion Management

- Detectors
- Ramp meters
- High occupancy vehicle (HOV) lanes

Incident Response and Congestion Management

- First Incident Response truck in 1963
- Goodwill Games pilot program
- Expansion of IR Program

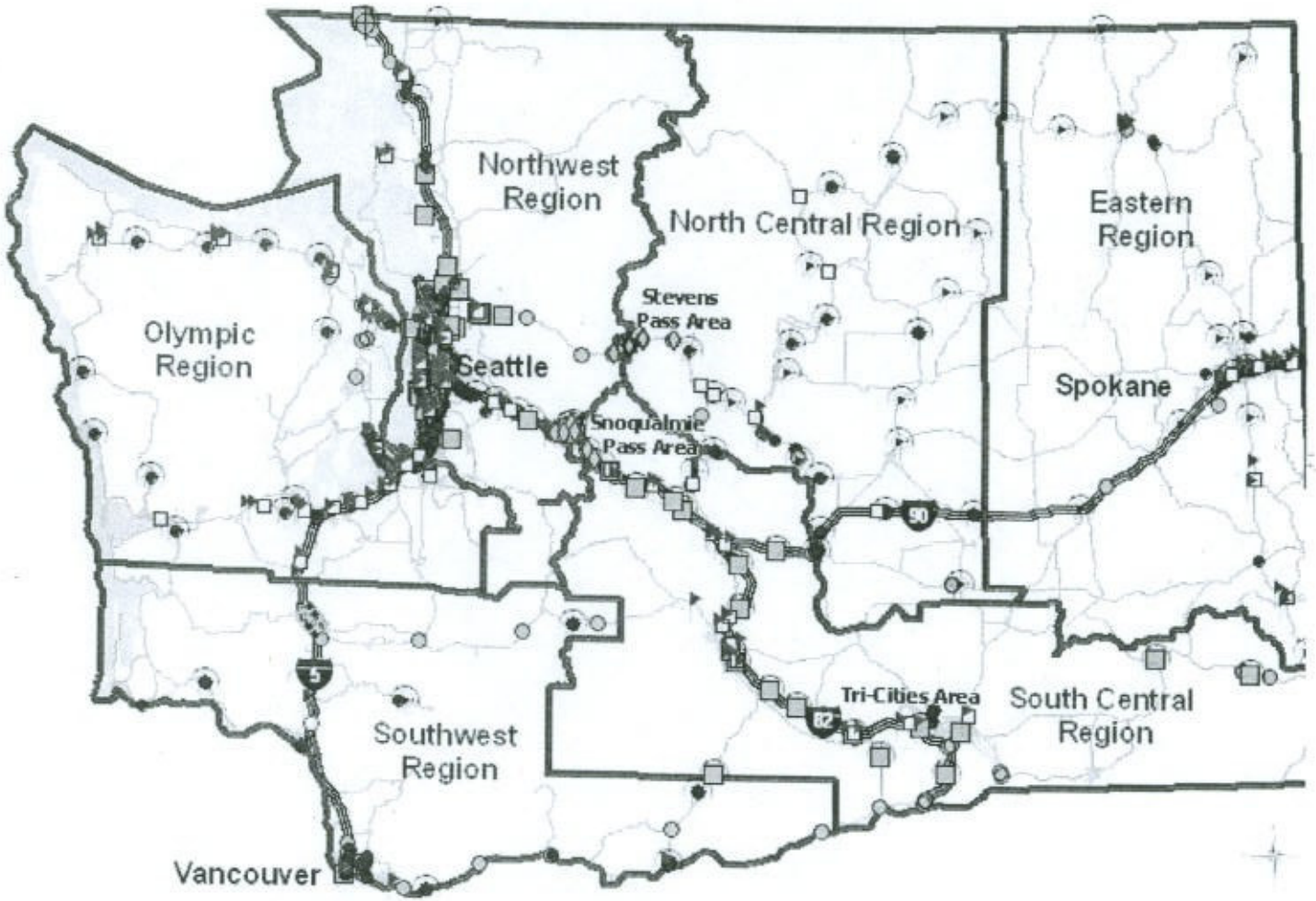
"I waited less than 5 minutes when he showed up - whole thing done in less than 15! Great! I had my toddler with me"
- Jessica Guthrie, Everett

Transportation Management Centers

- Seven traffic management centers monitor and coordinate operations on the state highways. They are the central point for ramp metering operations, traveler information distribution, and incident response operations

511 Travel Info

2007 Washington State Department of Transportation
Intelligent Transportation System Locations



All ITS Types Located Statewide

- Remote Traffic Microwave Sens
- Over Height Detector
- License Plate Reader
- Variable Speed Limit Sign
- Highway Adivisory Radio Sign
- Highway Advisory Radio Transmitter
- HART (Portable)
- CCTV
- Snap Shot Camera
- Roadway Weather InformationStati
- Ramp Meter
- Changeable Message Sign
- Variable Message Sign
- CCTV, Existing

Active Traffic Management: The Next Evolution in Congestion Management

Imagine…

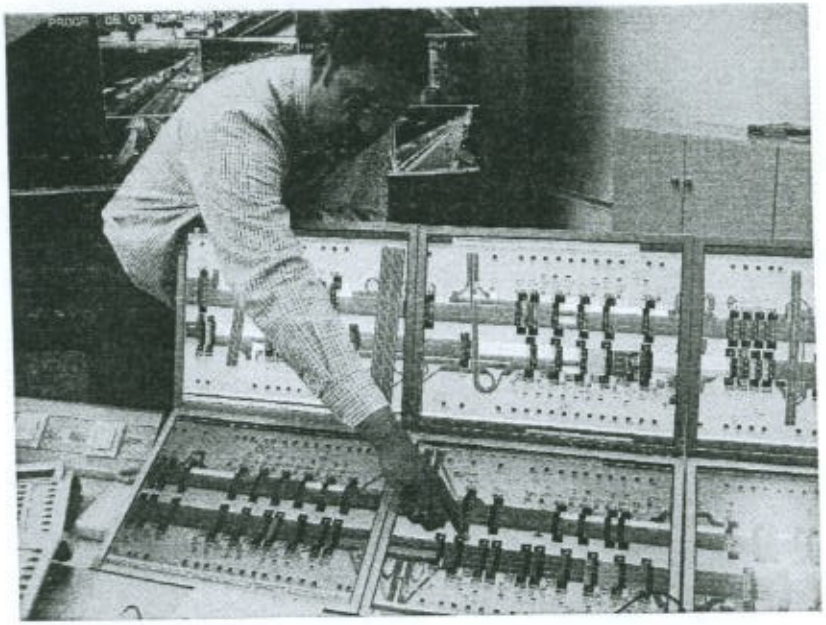
A freeway that lets you know exactly what's going on ahead

A freeway that warns you to slow down to avoid hitting stopped or slowing traffic

A freeway that can merge traffic left to allow heavy merging traffic to enter

A freeway that adds a lane at peak times when it's needed

A freeway that directs you to the fastest route



International Scan Summary

- In June, 2006, 11 transportation professionals visited 5 European countries to study how these nations were addressing congestion on freeways.
- Sponsors AASHTO, FHWA and TRB.
- Countries visited included Greece, Germany, Denmark, the Netherlands, and the United Kingdom.

Overall Observations

The scan team originally went to look at managed lanes in Europe. What we saw was a comprehensive, extensive, and customer-oriented approach to operating the system known as Active Traffic Management – something the US could learn from.

Physical characteristics of an actively managed freeway system

- Traffic detection (loops, radar, or other)
- Overhead gantries (about every 500 meters – close enough to see the next one) with speed limit signs over each lane
- Hard shoulders capable of bearing traffic
- Ramp meters
- Variable signage
- 24/7 Traffic Control Centers
- Incident response team
- Cameras
- Emergency Refuge Pull-offs

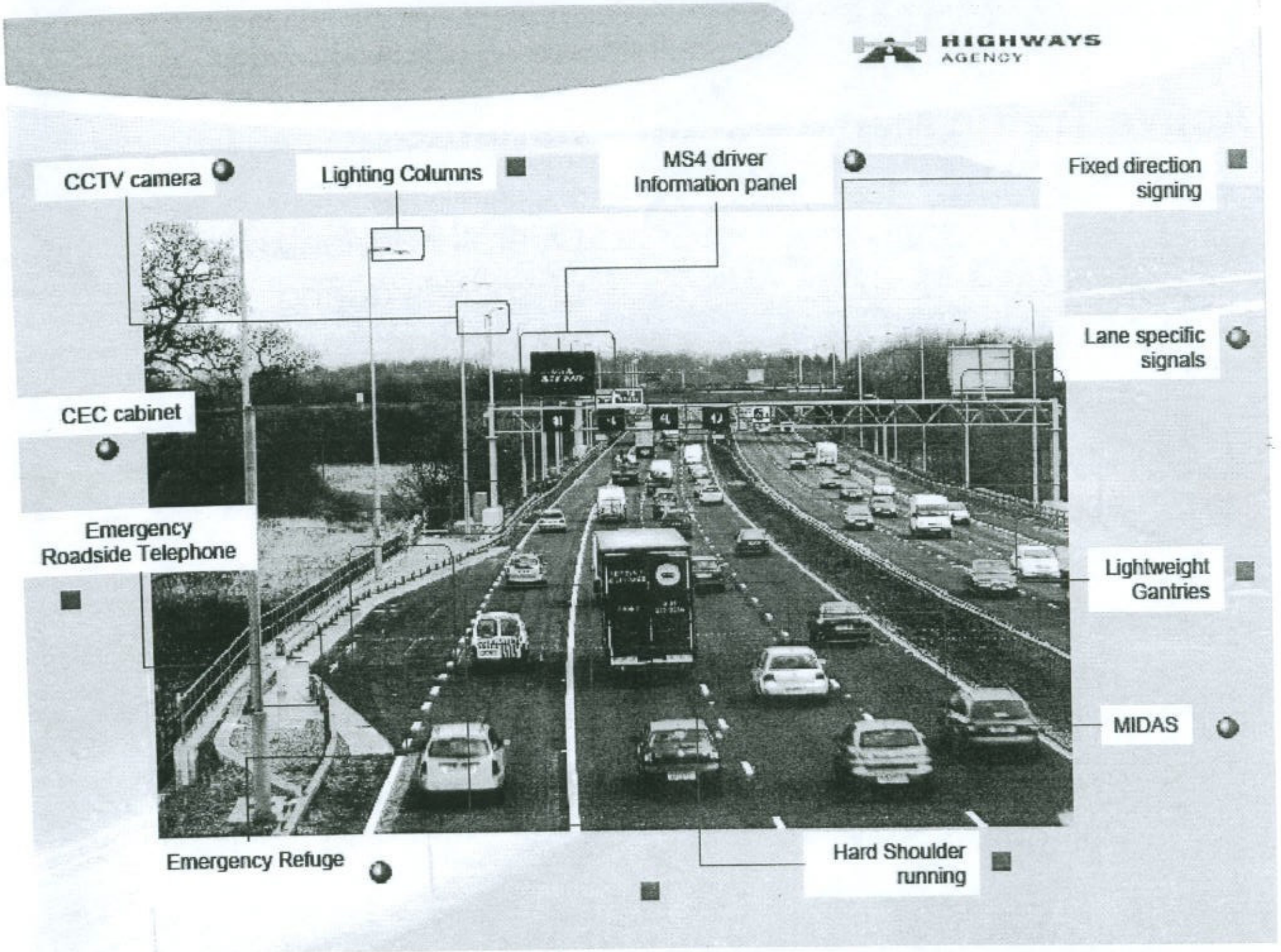
Active Traffic Management - Benefits

- Average throughput increase: 3 - 7%
- Overall capacity increase: 3 - 22%
- Decrease in primary accidents: 3 - 30%;
- Decrease in secondary accidents: 40 – 50%,
- Travel time savings up to 20%
- Emergency Refuge Pull-offs
- Overall harmonization of speeds during congestion
- Decreased headways and more uniform driver behavior
- Increase in trip reliability, safety
- Delay the onset of freeway breakdown
- Public Trust

Actively managed freeway applications

- **Speed Harmonization**: dynamically and automatically reducing speed limits in areas of congestion, accidents,or special events to maintain flow and reduce risk of secondary accidents
- **Queue Warning**: lowering speed limits approaching congestion to prevent 60 mph meeting 30 mph
- **Traveler information**: letting travelers know what is going on to make better up front route/mode decisions, better in-route decisions, and communicating what is happening ahead to cause reduced speed limits
- **Temporary shoulder use**: adding a lane of traffic on the shoulder (right or left) during congested conditions
- **Junction Control**: moving traffic to the left to allow merging traffic to enter more smoothly
- **Dynamic Rerouting**: changing destination signs to account for traffic conditions
- **Truck Restrictions**: limiting trucks to the right lane during congested conditions to maximize throughput of the other lanes

HIGHWAYS AGENCY

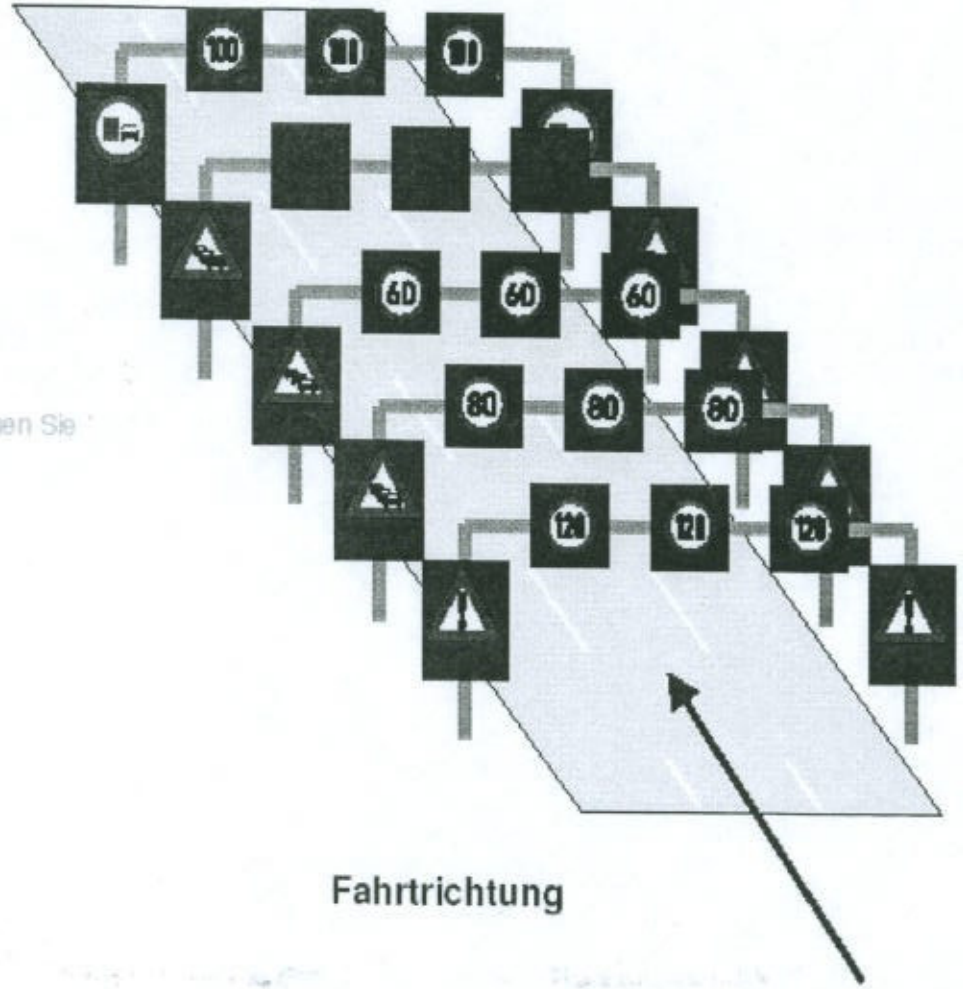


Line Control – Basic Principle

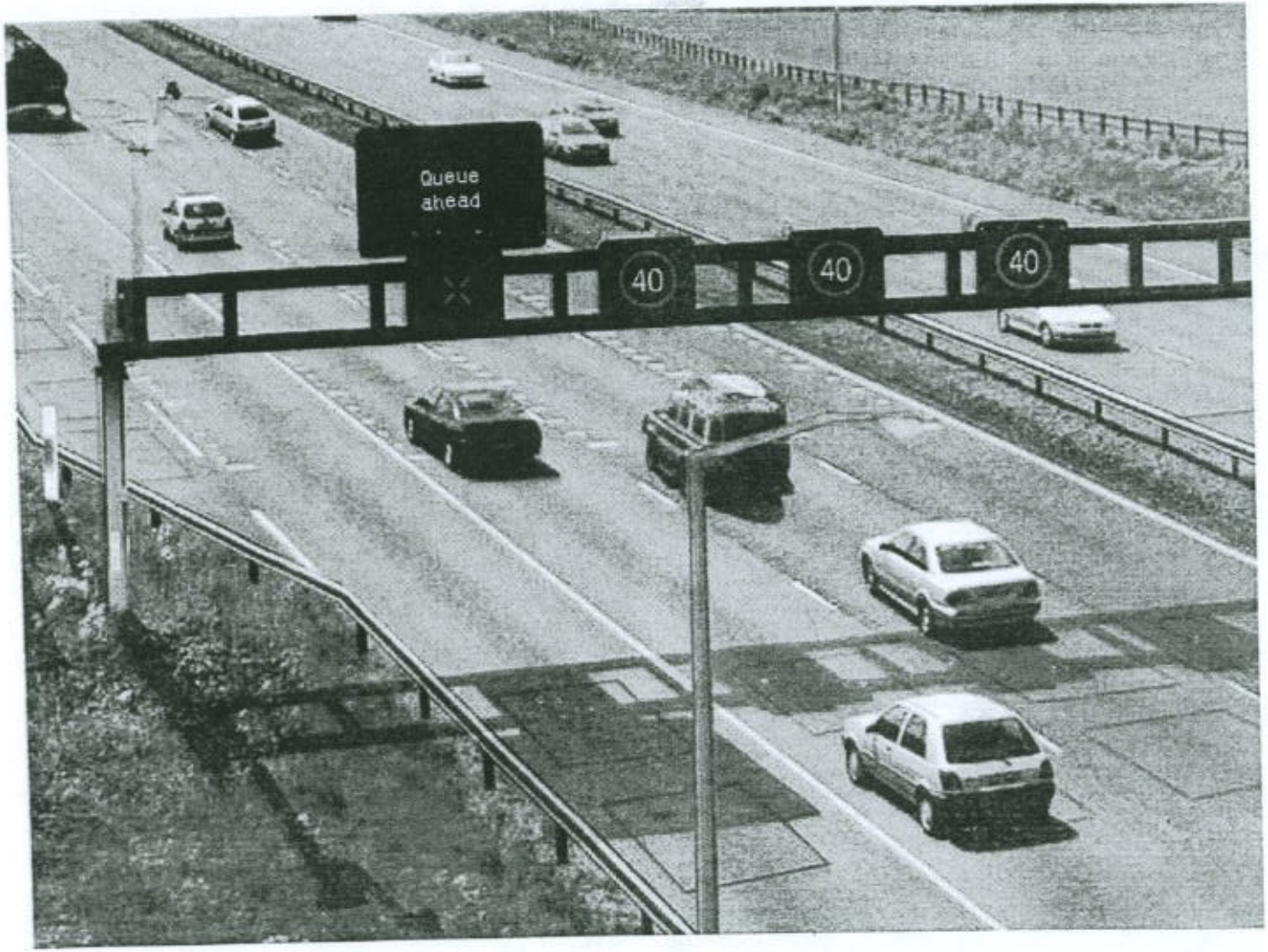
Hier verlassen Sie den Stau

Hier befinden Sie sich im Stau

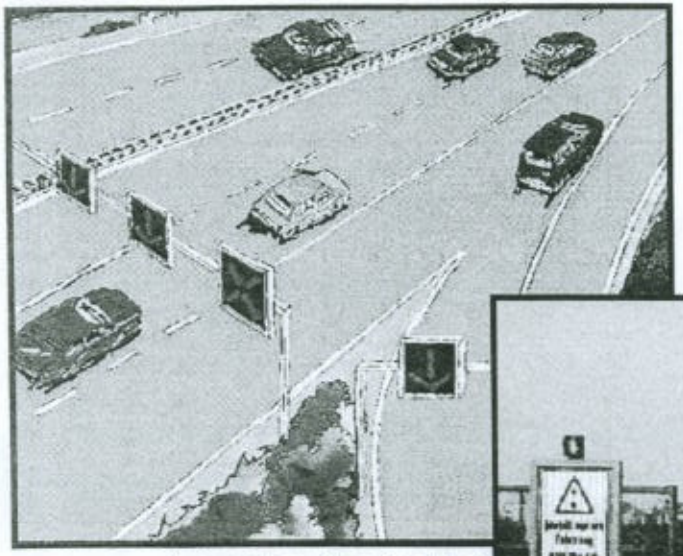
Hier erreichen Sie den Stau



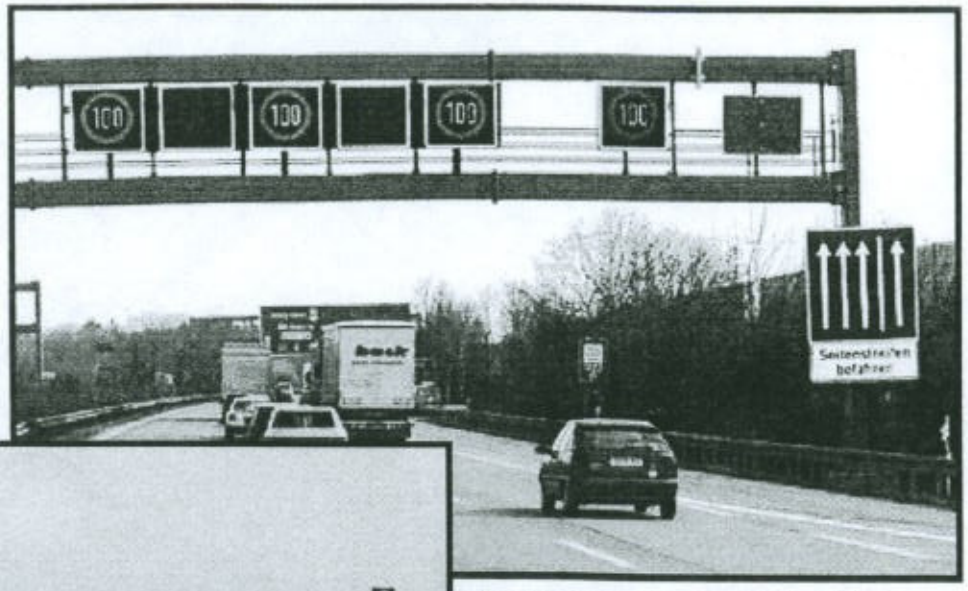
Fahrtrichtung


Queue
ahead
40
40
40

Germany



Junction Control at Ramp



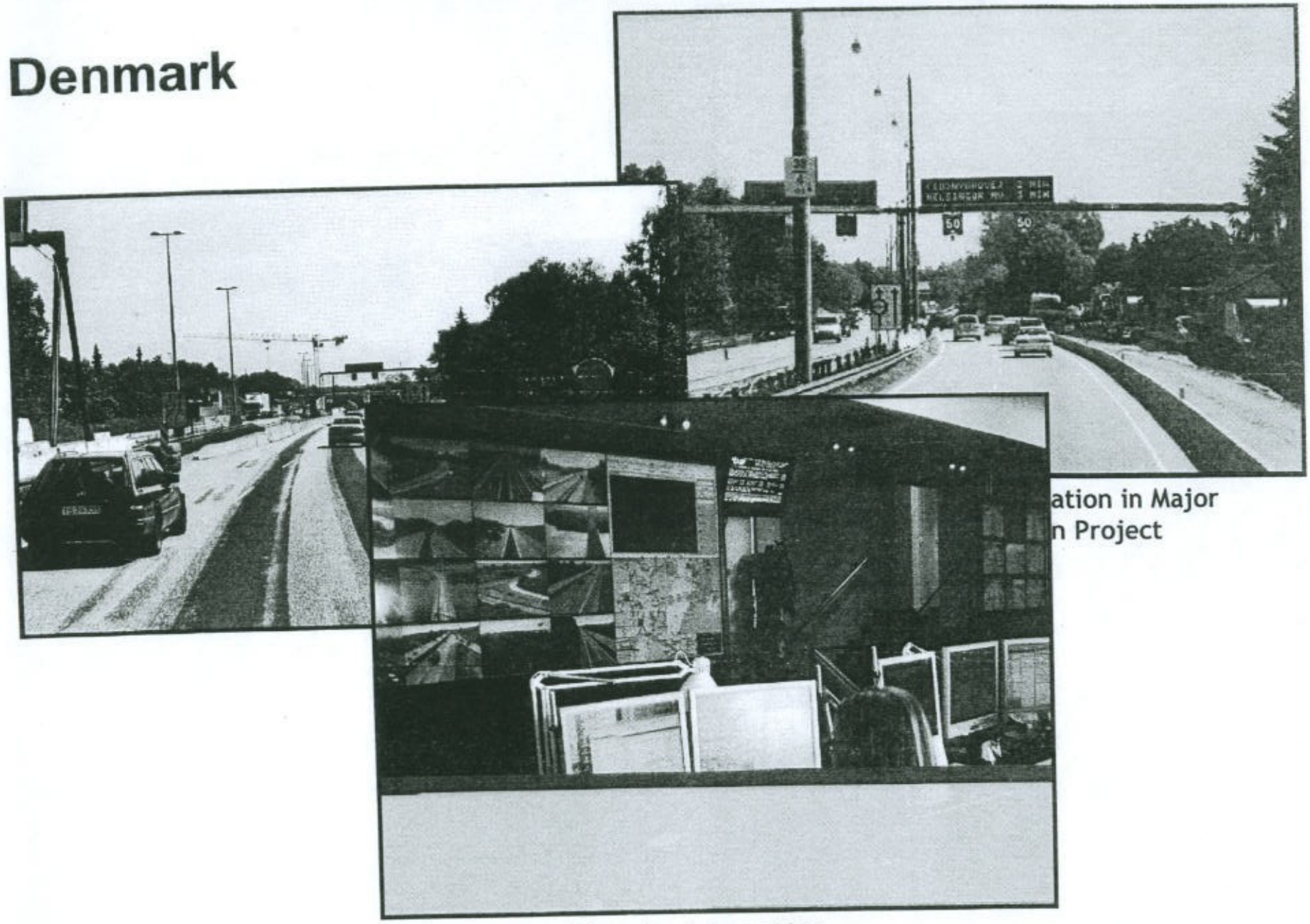
/ Temporary Shoulder Use

Metering

Dynamic Re-routing

Distance-based Truck Tolling

Denmark



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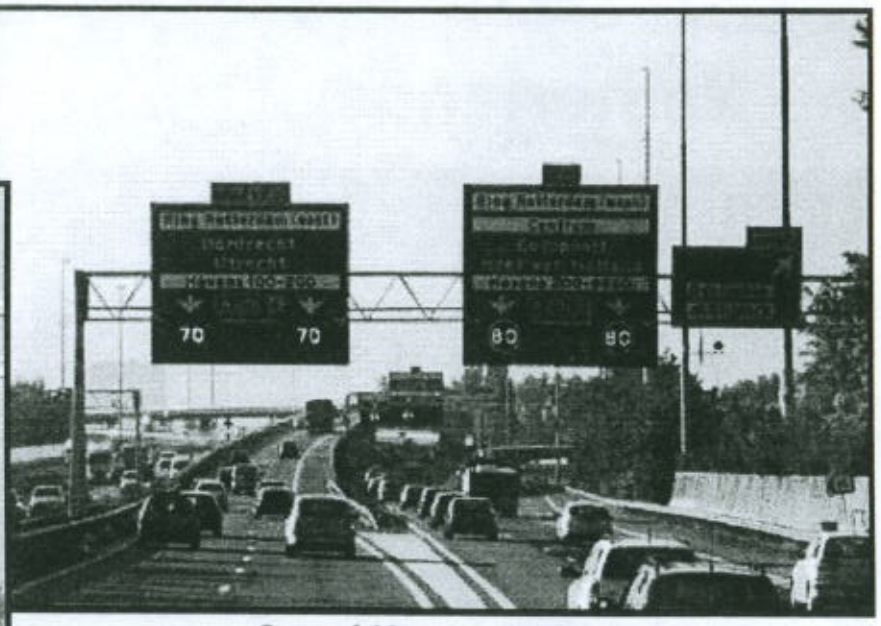
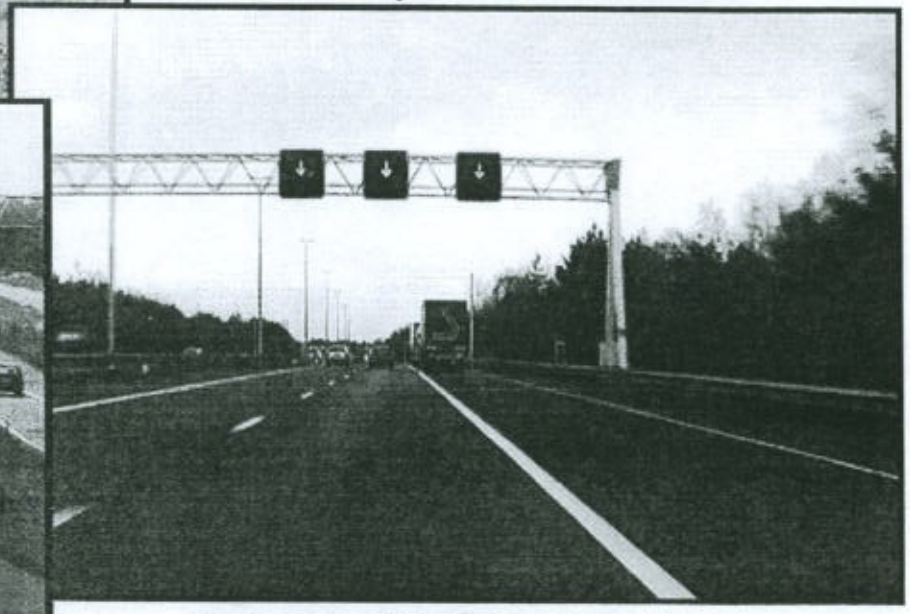
Traveler Information

The Netherlands



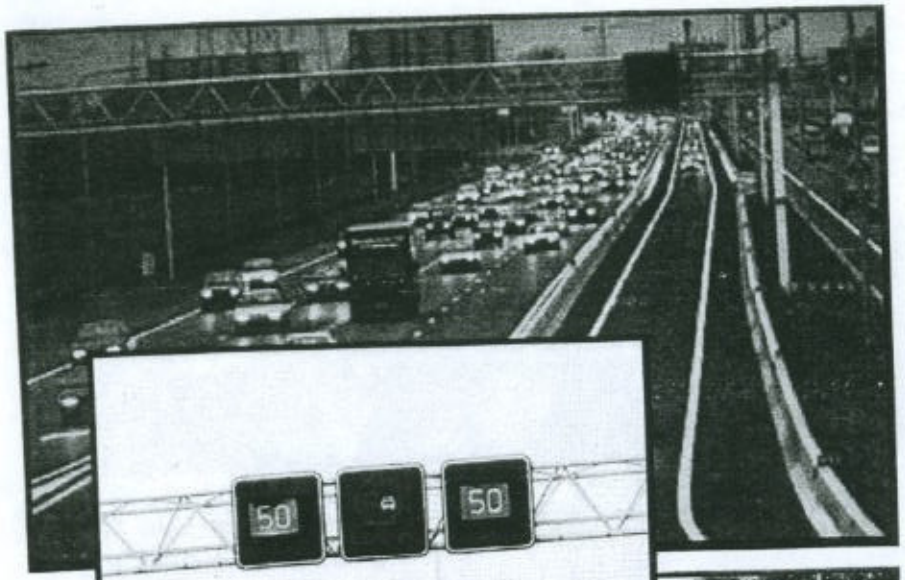
Speed Harmonization

Plus Lane - Temporary Left Shoulder Use



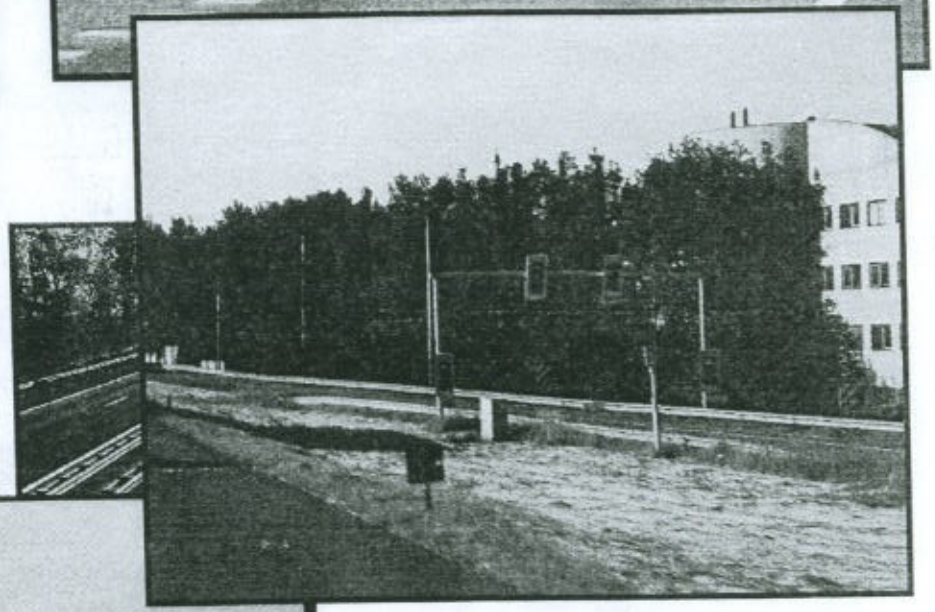
Temporary Right Shoulder Use

The Netherlands



Dynamic Truck Restrictions

Dynamic Pavement Markings

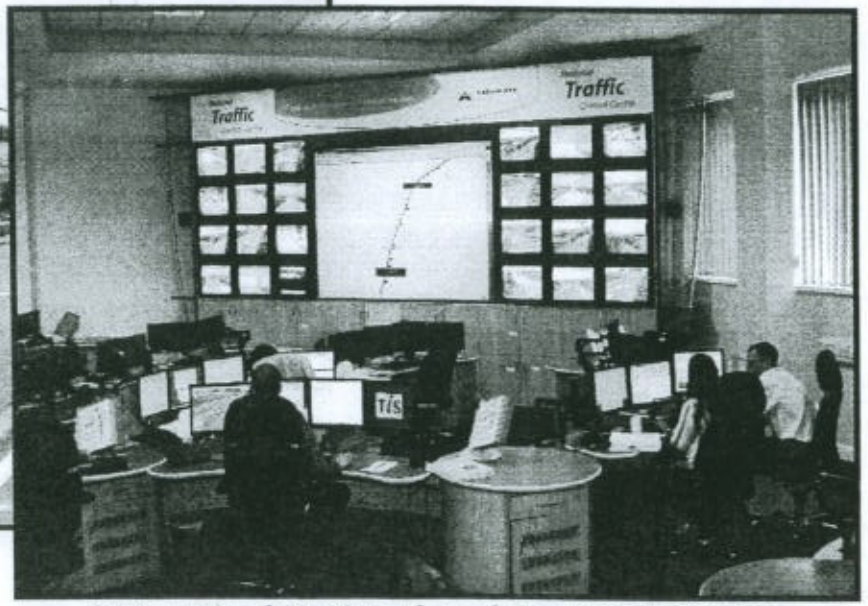


Ramp Metering

England

Speed Harmonization

Speed Harmonization / Temporary Shoulder Use



Integrated National and Regional Traffic Control Centers

Overall Observations

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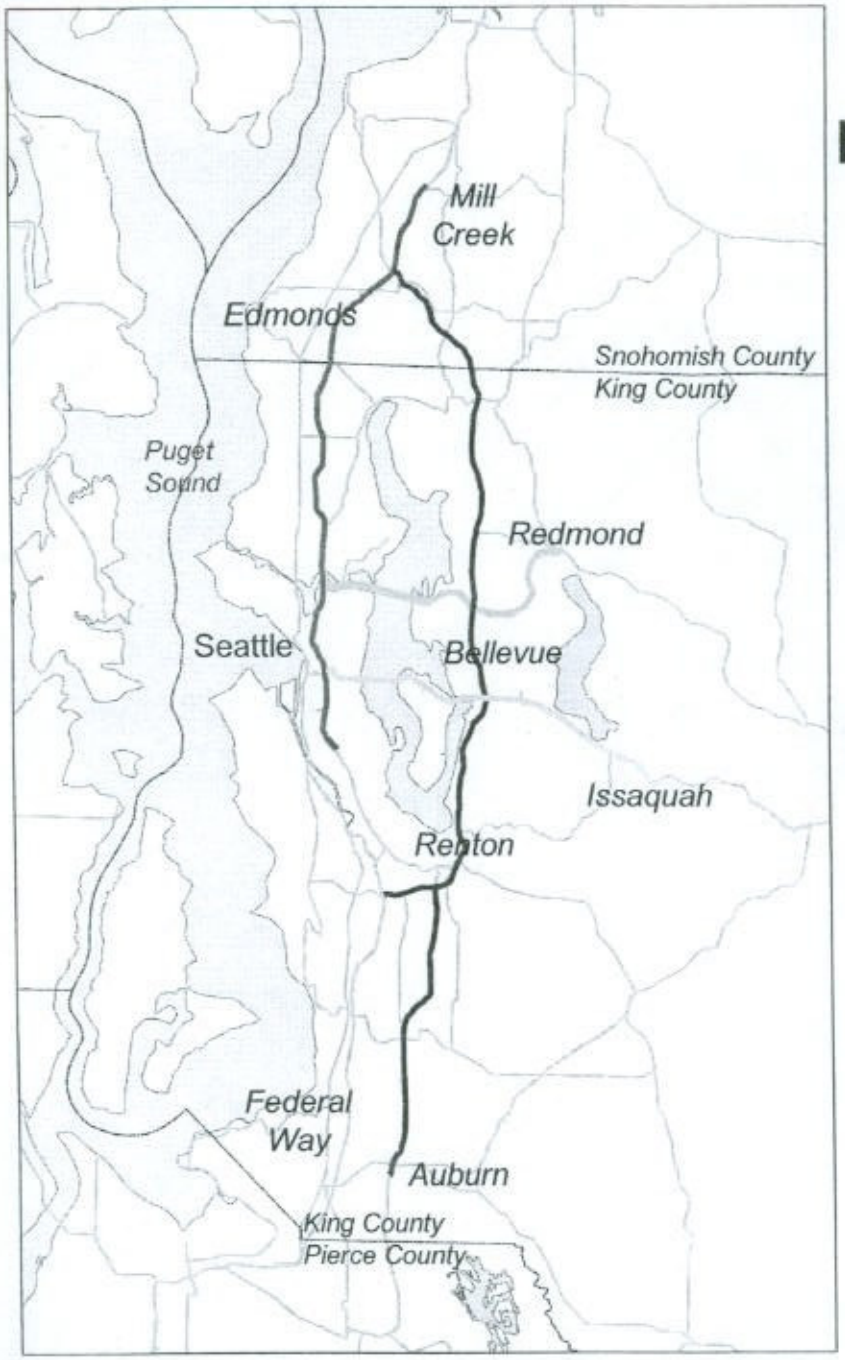
What we saw was a comprehensive, extensive, and customer-oriented approach to operating the system known as Active Traffic Management – something the US could learn from.

What do we know here in Washington State

- *We have the least performance from our roadway system when we need it the most*
  - *In some cases like on I-405, we loose half the capacity because of congestion*
- *Maximizing the efficiency of our corridors to move the most people and goods comes when freeway speeds are reliably maintained between 40 – 50 mph*
- *Our delay comes from recurrent and non-recurrent congestion similar to the European experience*



Puget Sound Feasibility Study

WSDOT and PSRC partnered to evaluate major transportation corridors for best applications of active traffic management techniques observed in Europe to maximize capacity and increase safety of critical freeway corridors.

Interstate 405 / State Route 167 Corridor

Interstate 90 / State Route 520 Corridor

Interstate 5 / Alaskan Way Viaduct

Key Study Findings

- Initial findings are positive, particularly regarding collision reduction.
- Coordinated system of location specific techniques, with the resources necessary to operate them, is key.
- Potential for implementation I-405, SR 520 and I-90 (UPA grant), I-5/SR 99 Alaskan Way Viaduct.
- Need to educate political decision makers, policy makers and the public